

Expedition Energy Transition: Educational Innovation for Building Tomorrow's Energy System

1. Applicants

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dr. Ksenia Podoyntsina	Assistant professor Innovation, Technology Entrepreneurship and Marketing (ITEM) group.
Boukje Huijben, MSc.	Project manager Energy Transition Lab EEI; PhD candidate System Innovations and Sustainable Transitions group (expected end date: December 1, 2015).

2. Background: Eindhoven Energy Institute and the Energy Transition Lab

One of the grand challenges our society is faced with today is its unsustainable energy system. We need a major shift in the way we fulfill our energy needs: an energy transition. This requires a systemic approach that involves many stakeholders and that builds on new types of knowledge, tools and skills. That implies a need for a shift in the role of the university towards facilitating and encouraging processes of co-creation with outside parties and educating (future) energy professionals who would have the competencies to act as change agents. At the Eindhoven Energy Institute (EEI) of the TU/e we are developing the Energy Transition Lab that would support this endeavor.

In that context we are currently actively involved in a number of (international) educational activities for professionals who are involved in aspects of energy transition in various capacities. In this process we collaborate with various agencies but mostly with the KIC InnoEnergy, the Climate KIC and the International Energy Agency. Content wise we build on academic knowledge in the field of transition studies and business models (management literature), as such combining the broader societal systemic and company level perspectives. This knowledge base is continuously advanced and new insights emerge from a great number of research projects initiated by the System Innovations and Sustainable Transitions group (School of Innovation Sciences) and the Innovation, Technology Entrepreneurship and Marketing group (school of Industrial Engineering).

The aim of our educational activities is to translate the available academic knowledge into practice and boost renewable energy projects of professionals in a way that they can factually contribute to making a change. We work with a range of transition approaches that support acquisition of competences that are indispensable for working on transitions to sustainability (i.e. scientifically supported methods; Appendix A). Simultaneously we make use of a set of interactive co-creation teaching methods that facilitate a much more efficient gaining of new skills (Appendix B). Lecturers function as coaches guiding the participants through a process of interactive learning and co-creation rather than academic teachers focused on provision of knowledge. This type of innovative educational activities was so far limited to professional trainings for experts already working in the field. As much as such education is key to

supporting the process of energy system transformation, proper education started earlier on in the individual carrier has a much higher chance of resulting in factual change. Universities are not yet equipped with appropriate curricula and prepared staff to commit to this type of responsibility but they might need to soon start thinking about that as the urgency of solving grand societal challenges becomes truly pressing.

3. Objectives

3.1. Project objectives

This pilot aims to fill in this gap. In particular, it aims at transfer of available academic knowledge and knowhow into practical contexts with which students are faced once they graduate from the universities and embark on a professional carrier We plan to do so in the form of a certificate program for excellent students, initiated and managed by the EEI, which we aim to extend into a full master honours track after the pilot¹. In the context of this program students would propose their own practical project or an idea that aims to solve one or more of the societal challenges related to the energy transition and consider its advancement by means of using various transition and management approaches. We plan to experiment with interactive learning and co-creation by allowing students to explore both technical (prototype building) and social aspects of their innovation (interdisciplinary learning): Expedition Energy Transition. We plan a series of 6-8 interactive co-creation sessions in the program which will form the core of our didactical experiment (see below).

3.2. Student learning objectives (preliminary, to be further developed)

After successful completion of this course the students:

1. Can identify and reflect on the major social challenges related to the energy transition in various economic and political contexts.
2. Can use 'integrative' competencies to analyse and deal with societal and institutional aspects of energy technologies in a self-developed project. The competencies include a.o.:
 - a. Systemic, foresight and strategic thinking;
 - b. The ability to collaborate with scholars from different disciplines (interdisciplinarity) and practitioners (transdisciplinarity);
 - c. The ability to monitor, reflect and adjust the assumptions and the process.
3. Can create and implement a new business model for the selected technology;
4. Have created a prototype of the selected technology.

4. Expected outcomes of the pilot

- Evaluation of opportunities for wider implementation of the program:
 - institutionalized in master honours tracks of the TU/e;
 - (parts of) program institutionalized in other educational programs of the TU/e (e.g. certificate program, existing master honors programs);
 - program adapted for high school students (e.g. when visiting the TU/e);
 - teaching methods applicable to other domains (e.g. health, mobility);

¹ The EEI is currently also responsible for the energy track of the bachelor honors college.

- If possible, continuation of honors projects as EEI student project, start-up company or otherwise²;
- Presentation at 3TU.CEE activity (e.g. Innovation Day) and dissemination of learnings via 3TU.CEE website.

5. Project design and management

5.1 Overall course setup

For the pilot we aim for a total of about 10-15 master students (2-3 groups of 4-5 students, preferably from different study backgrounds) from various master programs to encourage interdisciplinary cooperation. We develop a one year program with a study load of 15 ects (about 10 hours per week) for which students receive a certificate. Depending on the outcomes we may decide to extend it to a two year honours program. Table 1 provides an overview of activities. Students select their own project which may originate from both within or outside the university. They work on both technical aspects (prototype building) as well as consider their project from a broader system innovations and business perspective in parallel. Both trajectories feed into each other. As such, students join ‘Expedition Energy Transition’ which stimulates *interdisciplinary learning and cooperation*. This will be enhanced by the different course elements as well as by variety in group members and supervisor backgrounds. We will also explicitly consider interdisciplinary learning outcomes in the setup and evaluation of our program.

Boukje Huijben will be the coordinator and main lecturer of the course. Anna Wieczorek and Ksenia Podoyntsina will be co-lecturers for the system innovation (transition) and business perspective parts respectively.

Table 1: Overview of educational activities for students (Expedition Energy Transition).

	Quartile 3 2015-2016	Quartile 4 2015-2016	Quartile 1 2016-2017	Quartile 2 2016-2017
Technology Track	<ul style="list-style-type: none"> • Subscription & introduction to the program; • Topic selection; • Working plan. 	Technology Prototype development		Reporting
Systems Innovation Track		Interactive co-creation sessions 1 (3-4), Excursion (1), Guest lecture (1).	Interactive co-creation sessions 2 (3-4), Excursion (1), Guest lecture (1).	

² The EEI is also responsible for the energy track of the bachelor honors college. Last year one project, the FAST car, was so successful that it will be continued this year as a student project (similar to the Stella car) and will be further supported by the EEI.

5.2 Interactive co-creation sessions as central topic of experimentation

A total of **6-8 interactive co-creation sessions** are planned in which different methods related to transition thinking and business model design will be considered and applied in students' projects (see Appendix A for an overview of transition methods). Co-creation comes into existence in 'the space between people' and is enhanced by diversity in backgrounds and talent (Swets et al., 2014). From our experience with professionals we have a range of interactive co-creation teaching methods available (see Appendix B) which we will use as a basis for these sessions. We will evaluate their potential for educational activities at the TU/e as well as their potential for co-creation. We are also involved in a working group for the setting up of an experiment for the development of co-creation teaching methods. If possible we will align our activities with the planned experiment.

5.3 Teaching activities and workload

An overview of the planning of teaching activities and load is provided in Table 2 and includes student recruitment and selection, preparation of the program, project supervision, teaching the interactive sessions and course evaluation.

Table 2: Planning of teaching activities for the pilot.

Teaching activity	Work load	Time	Persons involved
Student recruitment and selection	20 hours	January-mid February 2016	Boukje Huijben
Project supervision	100 hours	March – December 2016	Boukje Huijben
Preparation of interactive sessions	80 hours	January-March 2016 (Interactive sessions 1) May-August 2016 (Interactive sessions 2)	Boukje Huijben (40), Anna Wieczorek (20), Ksenia Podoyntsyna (20)
Preparation of excursions and guest lectures*	20 hours	Jan-March (Quartile 3), May-August (Quartile 4)	Boukje Huijben
Teaching interactive sessions	32 hours (0.5 day per session; 8 sessions)	April-October 2016	Boukje Huijben (16), Anna Wieczorek (8), Ksenia Podoyntsyna (8)
Evaluation: preparation of evaluation plan, continuous monitoring and final evaluation report (due December 2016).	55 hours	January 2016 – January 2017	Boukje Huijben (30) and ESoE (25)

* We aim to cooperate with Annemieke Vennix (ESoE) who is doing research on outreach activities for students to include best practices in the setup of these activities.

Risk management

Risk	Risk prevention measures
Not enough students recruited	Early advertisement, linking with team Energy and study associations, support CEC.
Teachers unavailable	Pool of experienced teachers available (also from outside TU/e).
Delays in the management of the course	Detailed planning including evaluation plan will be made in January 2016.

Evaluation

In cooperation with Perry den Brok (Eindhoven School of Education, ESoE / 3TU.CEE) we will prepare an evaluation plan including performance indicators (January-February 2016). We also plan 2-3 intermediary evaluation moments with people from the ESoE as well as in-class observations and in between student evaluations. In November-December 2016 we will prepare an overall evaluation report including an overview of most important lessons learned and an exploration of options for further extension of the program and implementation for other educational programs of the TU/e and other target groups (see above).

References

Schwets, H., Schreurs, M. and Verbeek, B., 2014. Skills & co. Leren ontwikkelen en innoveren door co-creëren en design.

APPENDIX A: OVERVIEW OF TRANSITION SKILLS AND RELATED METHODS

Overview of transition competences and related methods which we use in our programs for professionals (Andringa and Weterings, 2006. Competenties van transitieprofessionals).

Competentie cluster	Persoonlijke vaardigheden	Methoden en technieken	Bijpassende rol < <i>divergerend</i> > <i>convergerend</i>
Patronen herkennen	- onbevangen vragen stellen - analytisch vermogen - conceptuele kracht - integraal denken	- integrale systeem-analyse - actor- en netwerk-analyse - historische regime-analyse - fact finding	Onderzoeker < Manager >
Heroriënteren	- visie en inspiratie - lef en overtuigingskracht - creativiteit - historisch besef	- scenario-analyse - toekomstverkenningen - back casting - reframing	Vernieuwer < Onderzoeker < Groepswerker > Manager >
Experimenteren	- alliantie management - mobiliserend vermogen - ondernemerschap - organisatievermogen	- actor- en netwerkanalyse - strategisch niche-management - lerend ontwerpen	Vernieuwer < Netwerker < Manager > Groepswerker >
Verankeren en opschalen	- anticiperend vermogen - ondernemerschap - overtuigingskracht - networking en lobby	- actor- en netwerkanalyse - integrale systeemanalyse - strategisch niche-management	Netwerker < Onderzoeker < Manager >
Monitoren	- observatievermogen - reflectief vermogen - nieuwsgierigheid - zelfbewustzijn	- transitie monitoring - evaluatietechnieken - learning histories - reflectiesessies	Onderzoeker < Groepswerker >
Transitie management	- systeemdenken - gevoel voor timing - balanceren tussen inhoud, proces en resultaat		Onderzoeker < Groepswerker > Manager >

APPENDIX B: OVERVIEW OF INTERACTIVE CO-CREATION TEACHING METHODS

The below examples of interactive co-creation teaching methods stem from the Pioneers into Practice and Innovator Catalyst programs of the Climate-KIC in which we are actively involved (Sterrenberg, Andringa, de Vincente, 2015. Toolkit training and coaching Pioneers into Practice 2015). Transition thinking and business model development are central in these programs. We combine these with the methods presented in Appendix A to provide participants with the necessary knowledge, tools and skills for becoming a transition professional and for boosting their individual projects.

- Getting to know each other: Looking for...
- Getting to know each other: One picture tells more than a thousand Words
- Getting to know each other: Poster Gallery
- Getting to know each other: Speed Dating
- Introduce and Inform: Roundtable Controversy
- Introduce and inform: Listen carefully
- Introduce and inform: Reconstruction
- Introduce and inform: Standing on a Piece of Paper
- Introduce and Inform: Sketch Noting
- Introduce and inform: Theory Sandwich
- Introduce and inform: True or false?
- Exchange knowledge or insights: Buzzing
- Exchange knowledge or insights: Collect all the Cards
- Exchange knowledge or insights: Dilemmas
- Exchange knowledge or insights: Open Space
- Exchange knowledge or insights: Think ahead
- Exchange knowledge or insights: The Student as Expert
- Brainstorm and create support: ABC
- Brainstorm and create support: Glasses
- Brainstorm and create support: Nominal group technique

- Brainstorm and create support: Need assessment
- Brainstorm and create support: Visioning and Backcasting
- Brainstorm and create support: World Café
- Reflect: Daily Weather Report
- Reflect: Group Self-assessment
- Reflect: Individual Reflection Cards
- Reflect: Three Words



Figure A.1. Pictures from Pioneers into Practice and Innovator Catalyst interactive sessions (Sterrenberg, Andringa and de Vicente, 2015).